

SIXPENCE

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.. A LOW POWER MAGNETRON ..

By F. P. Dickson. VK2AFB

The Magnetron is never likely to be very suitable for amateur transmitters because of its poor frequency stability and the difficulty of modulation. Its principle of operation however, may yet be of great importance to us in UHF work since a recent development wherein the Magnetron is combined with a cavity resonator. This results in a valve capable of operating at extremely high frequencies with good efficiency and stability. This type of valve is called the "Turbatron" and will be referred to later.

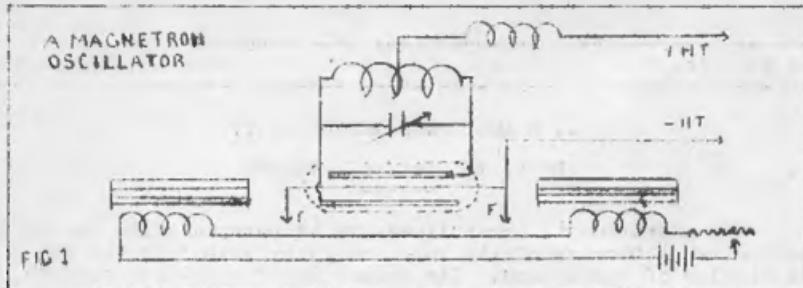
With a view of finding out something of how the Magnetron works in practice several experimental valves were constructed. One of these was particularly successful and was demonstrated at a recent N.S.W. Divisional Meeting. The valve was made quite small, and for the sake of simplicity a plain Tungsten filament was used, which gave quite sufficient emission for the purpose. The two half anodes, since it was a "split" anode magnetron," were 18 mm in length and 2.5 mm radius. These were mounted with a gap of 0.5 mm between their edges.

The filament was mounted along the centre line of the assembly, very nearly parallel to it. Some slight deviation from symmetry is necessary since with a perfectly symmetrical arrangement oscillation will not start. The whole assembly was sealed in a T9 bulb.

To provide the necessary magnetic field an electromagnet was set up with a pole gap sufficient to admit the bulb, the windings being on two bobbins and the magnetic circuit completed through a massive soft iron yoke. This magnet was energised from a 6 volt battery and drew 3 amps with the 15 ohm control rheostat all out.

For low frequencies a coil and condenser were used in the tuned circuit, connected between the half anodes, while for frequencies above 100MC, parallel rods were used. The lowest

and highest frequencies observed were 12MC and 250MC. At 250MC however, the output was poor because the pinch type of construction was unfavourable at these frequencies. Lecher wires were used for measurement in this range, loosely link coupled to the oscillator, see Fig 1.

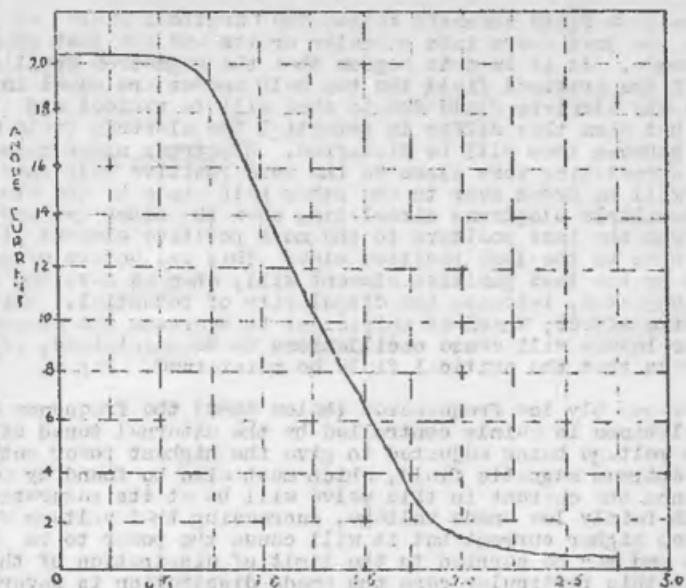


The electrical characteristics of the valve are few and simple:-

Fil Current ... 2.5 amps
Anode Voltage ... 300 volts.
Anode current
 (no field-) ... 20 M/a
Anode current
 (max field)... 0.8 M/a
Anode dissipation. 7 watts.

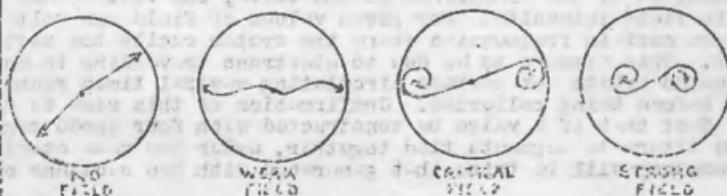
The valve is set up between the poles of the magnet so that the lines of the magnetic field are parallel to the axis of the assembly. If current be drawn from the two half anodes tied together and the magnet not energised, about 20 M/a will flow. This is all the emission available at the particular filament temperature and about 60 V would be enough to draw it over. The electrons proceed in straight radial lines to the anode with velocities depending on filament temperature and the gradient due to the anode voltage (300 volts).

If now the magnet is started it will be seen that at a certain field strength the anode current will begin fall and then drops very rapidly with increasing power till a low value is reached, beyond which the current cannot be much decreased. See Fig 2. This may be explained by the fact that an electron being a moving electric charge, will tend to alter its direction of motion in accordance with the Left Hand Rule. In this case the electrons change from their straight radial paths to paths of increasing curvature till they finally are travelling in circular orbits round the lines of magnetic force and so do not reach the anode. A further increase in field makes the circles smaller as in Fig 3.



Control of anode current by field magnet

FIG. 2.



How the magnetic field causes the fall of anode current. Electrons behave according to Fleming's Left-Hand Rule.

FIG. 3. A diagram showing the effect of a magnetic field on the path of an electron.

There is a field strength called the "Critical Field" where electrons are just drawn into circular orbits and are just grazing the anode. It is in this region that the Magnetron Oscillator works. If the critical field, the two half anodes are equal in potential, the electric field due to them will be radial and uniform, but when they differ in potential the electric field near the gaps between them will be distorted. Electrons under these conditions, circulating very close to the more positive half anode near the gap, will be drawn over to the other half anode by the distorted field. Similarly electrons circulating near the other gap and tending from the less positive to the more positive element will be drawn back to the less positive side. This collection of more electrons by the less positive element will, when a have the tuned circuit connected, increase the dissimilarity of potential. This is a cumulative effect, which if sufficient to overcome the circuit resistance losses will cause oscillations to be maintained, provided always that the critical field be maintained. Fig 4.

At reasonably low frequencies (below 50MC) the frequency of the oscillations is mainly controlled by the external tuned circuit, the anode voltage being adjusted to give the highest power output with the optimum magnetic field, which must also be found by adjustment. Since the current in this valve will be at its saturation value with fairly low anode voltage, increasing that voltage will not produce higher current but it will cause the power to be increased and may be carried to the limit of dissipation of the anode. In this particular case the anode dissipation is severely limited by the risk of filament bombardment.

In the higher frequency range other factors become of greater importance and at very high frequencies the external tuned circuit is merely resonated to the frequency generated in the valve. This is controlled by the dimensions of the valve, the voltage and the magnetic field intensity. For given values of field and voltage there are certain frequencies where the system oscillates most readily. This appears to be due to electrons travelling in more complicated orbits and perhaps circulating several times round the system before being collected. Confirmation of this view is given by the fact that if a valve be constructed with four anode segments and the alternate segments tied together, under the same conditions the frequency will be twice that generated with two sections only.

It should always be remembered that in these valves the tuned circuit is connected between the anode segments and that the oscillatory currents are confined to this portion of the valve. The filament is purely a source of electrons and does not enter into the high frequency side at all. As a result, wiring can be made very short and there are no awkward by-passing or filament choking problems.

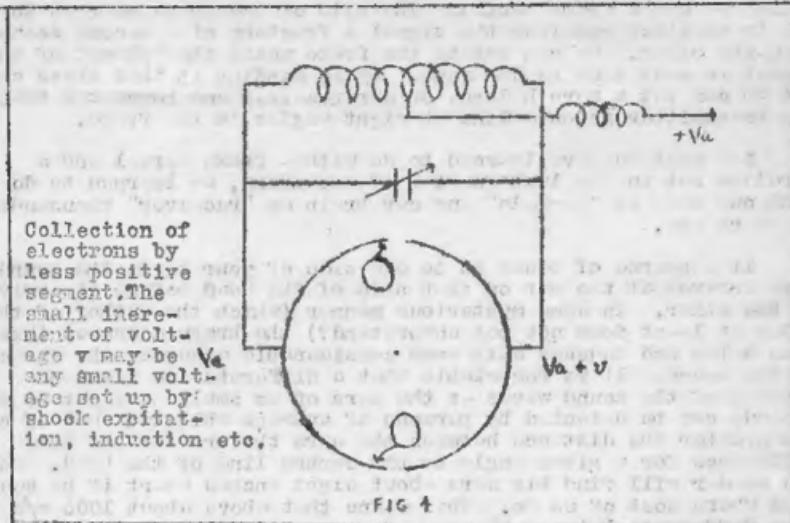


FIG 4

The "Turbatron" is an extreme type of Magnetron where the anode segments (as many as 6 or 8) are made part of the walls of a cavity resonator. Because of the high ϵ of the cavity resonator the frequency stability is good and the efficiency high, and since at very high frequencies the cavity resonators are physically small, they can be built into valves of reasonably size.

Modulation of these valves presents some difficulties. If the attempt be made at high frequencies to modulate either anode voltage or the magnetic field result in frequency shift or stoppage of oscillation. Success has been obtained by the use of grids, but this method was not tried in these low power valves, from lack of time.

Loop modulation, can of course be used, but in those days it could almost be described as unethical. An almost equally objectionable system was used here, that of modulating the filament current with the output of an audio amplifier super-imposed on DC heating current. Owing to the low thermal inertia of the filament the emission would follow the audio frequency and some modulation was obtained. It is not however, recommended for use in transmitters. It may be that these magnetrons can be frequency modulated and if that is the case, there may be many interesting possibilities for them.

SOUND WAVE DIRECTION FINDING

An interesting analogy between radio and sound waves concerns the effect of the direction of the source.

If we want to find the direction from which a radio wave is coming we use a frame aerial. The side of the frame nearest to the transmitter receives the signal a fraction of a second sooner than the other. We can rotate the frame until the "phase" of the signal in each side is the same. By so winding it that these cancel out we can get a zero balance on our receiver and hence say that the transmitter is on a line at right angles to the frame.

Now what we have learned to do with a frame aerial and a wireless set in the last quarter of a century, we learned to do with our ears as "aerials" and our brain as "receiver" thousands of years ago.

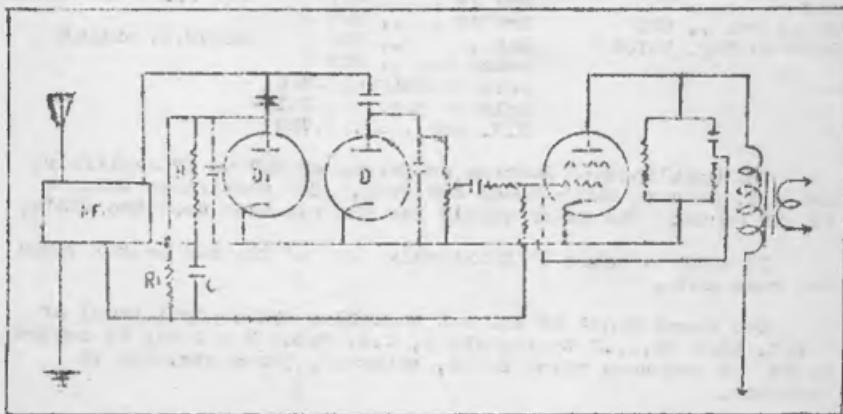
If a source of sound is to one side of your head, the sound wave arrives at the ear on that side of the head before it arrives at the other. In some mysterious manner (which the author of these notes at least does not yet understand?) the brain measures this time delay and deduces with some considerable accuracy the direction of the sound. It is remarkable that a difference in times of arrival of the sound waves at the ears of as small as about 50 microseconds can be detected by persons of average ability! Now of course the greater the distance between the ears the greater the time difference for a given angle to the centre line of the head. Now the reader will find his ears about eight inches apart if he keeps them where most of us do. This means that above about 1000 c/s the time difference between the ears for a sound fully to one side of the head represents more than one cycle. This introduces certain complications and we have to judge direction at high frequencies from the fact that the head screens the ear than the other. This is not so reliable as the use of time differences for we become dependant upon equal sensitivity of the ears which may depend upon our not suffering from catarrh!

This sheds some light upon the fact that small animals can make more use of higher frequencies than we can. In such tiny creatures as, for example, the crickets, the head is so exceedingly small that ears in the normal position on either side of the head would be so close together that the time delay would be so small as to be useless for direction finding of sounds. As this may be his only way of ascertaining the whereabouts of his wife, the matter is of some importance to a cricket! Nature has therefore thoughtfully placed the cricket's ears in his knees at which point he is the widest! He can thus find his way to (or from) her with surprising accuracy. That this directional ability is really due to air borne

AUTOMATIC VOLUME CONTROL

When receiving weak signals, the effect of AVC is to accentuate the high-pitched background of inherent noise. Similarly, when receiving weak signals on short waves, the tendency to rapid fading produces a low pitched frequency of the order of 60 to 80 cycles, which is likewise emphasized by AVC action, unless steps are taken to suppress the effect.

In the circuit shown provision is made to cope automatically with both drawbacks. Signals from the IF amplifier are fed through a diode rectifier D to the AF amplifier and loudspeaker the ordinary way. A second diode D1 supplies AVC voltage to a resistor R which is smoothed by R1 and C, and supplied both to the IF stage and the control grid of the AF amplifier. The output circuit of the latter includes a resistance capacity shunt from which a tapping is taken back to the control grid. The shunt impedances are such that the negative feedback automatically suppresses the very high and very low frequencies. The suppression comes into action only when the AVC control is near its maximum, i.e. when receiving weak signals.



Continued from page 6 -

waves and not to any form of ground vibrations has been proved by some ingenious experiments in which crickets were suspended by miniature balloons. It was found that they could still find their mates until one ear was destroyed, after which they answered each other, but could not judge the correct direction.

- From the T & R Bulletin.

-----o C o-----

A RECEIVER DE-LUXE

It is not uncommon to read in American Magazines of receivers of 15-18 tubes, but to read of a set using no fewer than 35 tubes gives one a bit of a shock. Yes--believe it or not such a set was described in a recent issue of Radio News. We regret that the publication of the circuit is beyond the scope of Amateur Radio, but for the interest of readers the details and tube line up may give someone ideas.

The set comprises:- Frequency modulation tuner. All wave tuner with noise squelching. Oscilloscope modulation meter (using a 902 cathode ray tube) and high fidelity audio amplifier with recording section incorporating a decimal meter. Taking the set section by section the tube lineup is as follows:-

<u>F.M. Section</u>	<u>Allwave tuner</u>	<u>Audio amplifier</u>
R.F. 7A7	R.F.1 7A7	7B4 ... 1st Audio
Mix Osc ... 6K8GTX	R.F.2 7A7	1612 ... Vol Exp
1st IF 1852	Mixer 7Q7	7A4 ... Vol Exp Amp
2nd IF 7A7	H.F.Osc 7C7	7A6.... Vol Exp Rect
Limiter 7C7	1st IF 1612	7A4 ... Tono Control
Dot 7A6	2nd IF 7A7	7N7 ... Phase Invert
Magic eye .. 6U5	3rd IF 7A7	
Voltage Reg. VR105	Dot 7B6	6B4GP.P. output
	Noise amp .. 7C7	
	Noise rectifier.. 7A6	
	Voltage reg. .. VR105	
	B.F. Osc 7C7	

The Oscilloscope Section comprises of 7A7 as IF Amplifier; 6FG 3.R. Driver; 902 cathode Ray Tube. The rectifiers being a 1V and an 84. The power supply for the receiver uses two 5Z3's.

It will be noted that extensive use of the new Loktal Tubes has been made.

The front panel of the set resembles the control panel of B.C. Station....3 tuning dials, C.R. Tube; 2 meters; 25 control knobs and numerous pilot lamps, switches, jacks etc. are in evidence.

All in all quite a handy little gadget to have around the shack.

"SEAFARERS, FOOTSLOGGERS and SKYWAYMEN"

(Incorporating ... Slouch Hats & Forage Caps) Hi!

.. By E YC ..

By the time we go to print next month I should have some news as to the popularity of our "pro-sem" heading - or have it superseded by a new effort.

By some oversight I left a rather important piece of news out of last month's column. News came over Tokio radio that F/O Bill Horne and our ex-Federal President and VK C Scenller is "alive and well." He did not broadcast personally and the message was very brief. It possibly points to Bill now being in Japan. Guess we all feel that's not so very good--but it is good to know he survived the taking of Batavia and is alive a year after so he should be Federal President in the future.

There is news of F/Lt. Douglas 3YK, who now seems to be stationed around Brisbane these days. He was luckier than Bill, getting out of Batavia - just in time.

Dec. Horne 2AIK - seems to have landed up Torres way along with Hannaford.

Rex Black 2YA - who did his sigs. rookie course with 3RJ, 9XX and 2WW way back in 1940, is now a F/O in Armament section--quite a change what! Rex has had plenty of changes. Went to Richmond sigs. office for a few months after finishing his training from dear old Ultimo, which in his day was "being only got ready" for use (hi). However two escort trips to Vancouver with Empire Air Scheme trainees, and the trip home with nobody to mind or to mind "them" should have made Rex look with favor on the R.A.A.F. But these trips came to an end and then Rex with Frank 2QL was interviewing the lads who wanted to be ops., remember them Ray, 2HC??? But the boys soon became replaced by girls and the day of the W.A.A.F's dawned. Next trip he had was a trip to Brisbane - where the place was crawling with "dit Happy" yrs, hi! (I particularly like dit happy, Rex--2YC). I don't know whether Rex got the dit Happiness but he took an Armament Officer's course and now looks at sigs. "from the outside." But the ham blood is there and occasionally the sigs office in the early hours of the morn gets a little "outside" help...hi!

Now I've got to "demote" somebody. I made Ted Peppercorn--2QJ, a Captain and he was only a Corporal. (Please Freddie, it was only a little mistake). Anyhow they have made him a Sergeant now--so you see I was right - Commission will not be long coming now - Ted. They always read my column in the "right" places.

VEEF - Bert Faull of Warracknebeal writes that he has now passed his Armourer's and fitter armourer's exam. and graduated from the school at Hamilton as L.A.C. His address now is - 58017, L.A.C. Faull A.E., Group 680 R.A.A.F. Bacchus Marsh.

ACI Dav, C.J -- VK3GY and former 200 metre merchant has now completed his wireless mechanics course and is awaiting posting. Clem is well known amongst the Western District boys, as for some years he was located at Camperdown.

VK3LN...Sgt. Len Moncur turned up at a meeting recently. Former distribution Manager of Amateur Radio, Len now spends his time as Radio Mechanic at Operational Station in Victoria.

VJ3HC...Sgt. Doug. Norman R.A.A.F. figured in the list of Awards recently gaining a "mention in Despatches. The citation reads" Sjt. Norman was in charge of the Wireless Detachmont at the time of the occupation by the Japanese Forces. He successfully evacuated his personnel and equipment, and although ill, continued to maintain a watch on all enemy aircraft in the area" - Congratulations, om....The occupation was that of Salamaua and for several months Doug was doing about the Territory and putting up what must have been "a good show".

Pilot Officer Len Burston VK3BV, formerly of Wangaratta is now at Mt. Gambier. Enlisting in 1939 as a W/T Op. Len went to Singapore in 1940 and arrived home last year after taking part in the trek from Kotto Bahru via Malaya, Sumatra and Java. Originally, he was on the same station as Roy Frowse VK3XS, but lost track of him during the last few days in Singapore. XS was one of the boys who was unable to get away and we hope to hear news of him, too, soon, even if it has to be over Tokio Radio.

Jack Coughlan VK3ST was last heard of instructing W.A.A.F.'s in VIM. It seems to be a Ham pastime, Hilt.

Another ham who has just finished his R.A.A.F. Wireless Mechanics Course is VK3EM, Ted Minifold. And from the same Course Bill Wonder of the old Fitzroy Radio Club also graduated.

Graham Colley 3QZ should by this time be sporting the uniform of a Pilot Officer. When last heard of Graham was attending the RAAF School of Administration. Nice going on....keep up the good work and one of these days you'll be an Air Marshall.

After being posted at the one place for over two years the powers that be at last remembered there was a chap such as Dick Gidlings 3MG. As a result Dick has at last reached the High Rank of Flight Sergeant. You'd better see 2LZ, Dick....they forgot and still forgot him...2YC.

Another ham to be heard of at long last is Ken Rankin 3YR. We believe that Ken is now a Warrant Officer, but no other details are to hand....but here's hoping....2YC.

Unforunatly, Hamdom like all other avenues of like in Wartime, must Pay the Supreme Price. It is with regret we list that Jim Colthrup VK3PL lost his life as the result of air operations over Europe.. no details are available. We extend our sympathy to his relatives and close friends and ensure that that Jim as 3PL will be always remembered by Hams scattered far and wide.

Alf Moye 2BW says that any hams passing through Wagga, and many a

do these days, will be very welcome if they call in at Anderson's Pharmacy in Bawlliss St. And don't forget Alf, when they do, pump 'em dry and send the news to "Alf's Column", H. After all, beer is scarce and a few tablespoonsful of it will get us tons of news Alf.

And lastly, and a tragedy for VKC...4RF has been moved from Canberra and I lose easily my most consistent helper in this column. As I have said how he managed to get the news was beyond me, but shows what can be done by you all wherever you are or how few hands you meet. 4RF now sails the Seas in the Manoora, now with H.N.A.S. in front of the name. Oh, well, son she is "cut above the old Jervis Bay...but more than that I couldn't say. H.H. That should be nice cheerful news. And what I want to know is...WHO sends me Canberra news these days...how about your Chief Party Officer????

And that is THAT. Many thanks VK3s for all the news from your end. One thing I want to avoid above all else is to have this a kind of VK2 affair. To put in the chorus...THIS is YOUR column..ALL of you, no matter where you are and I'll fill it as long as YOU send the dope. Thanks oms...

P.S. Did you see OUR ADVERT on the Back Page...???? (at least some one reads the adverts.....Ed "AR") ZYC.

D I V I S I O N A L N O T E S

.. Federal Headquarters ..

At the April Meeting of the Federal Executive members were informed that a very fine donation amounting to £15/13/6 had been received from the VK3 Division towards the Prisoner's of War Fund. This sum represented an amount of £10/13/6 that had been collected from among the Members and Five pounds had been added from the Divisional Banks. This generous gift raised the total to £41/7/6.

It was decided that the sum of £5/5/- be donated by Federal Headquarters to the Australian Red Cross: Prisoner's of War Fund and that each Prisoner of War whose address was known should receive a parcel of comforts. These parcels have now been despatched and if you know of a man who is a P.O.W. please forward his name, rank and address on to your Divisional Secretary or the Federal Secretary, Wireless Institute of Australia, 21 Tunstall Avenue, Kingsford, N.S.W.

....000....

NEW SOUTH WALES DIVISION.

The April General Meeting of the Division was held at Y.M.C.A. Buildings, Sydney on Thursday 15th April.

It had been intended to demonstrate the auxiliary power supply for the E.C.N. but due to a late delivery of the universal transformer it had been found impossible to complete the unit in time for the Meeting. This pilot model is being built up of Charles Fryar VK2NP and as he is quite a tradesman, members should not lose by the delay. This unit will be completed prior to the May General Meeting, and it is hoped that transformers will be available for distribution among Section Leaders.

An interesting letter from Morrie Lusby VK2WN who was attached to the Australian Legation at Washington, was read, and two colored prints illustrating a new color process in photography were passed round for inspection by members. Any old friend of SWN's who would care to write him, my address correspondence as follows:- M. Lusby, Scientific Liaison, Australia House, London, England.

At the conclusion of general business an interesting talk was delivered by Arthur Springatt VK2OM on his experiences at a certain local Police Station!

EMERGENCY COMMUNICATION NETWORK

Well, the first series of message handling exercises have been completed, and what a ding dong fight it was between VL2JI and VL2JJ and 2JI the eventual winner, the margin being 7 points. Right up to the last round only one point separated these stations, but during the last exercise 2JJ lost points through falling off in both quality and signal strength, scoring 43 points out of a possible 50 whereas 2JI totalled 49. Congratulations to Charlie Fryar VK2NP and his co-workers Alec Little and John Rothenbury. When stations were graded at the beginning of the month 2JI was in the "B" but this did not discourage these lads. They turned to with a will and in no time the beam was erected and right throughout the series their signal was one of the best.

The lads at VL2JJ, George Shelley VK2QK, Arthur Springatt, VK2OM, John Keane VK2JN and George Walcock should not be discouraged. Their's was also a fine performance and right up to the last minute they had a chance. Better luck next time fellows. This station is particularly well organised, each man quite capable of both operating the station and handling traffic. This is the way every installation should operate. Look out for VL2JJ next round!

Another Station to do well was VL2JL and in the last round scored 48 out of a possible 50 points, only one less than 2JL. George Littlefair VK2IV, George Patterson VK2AHJ and Ivan Baille VK2TN are keen and enthusiastic chaps all anxious for the station to do well. As an example of enthusiasm Ivan, 2TN, is constantly on night work, but nevertheless manages to get a long at least one night each month to handle traffic. Well done chaps.

Well here are the final points.

VL2JL	191	VL2JH	152
VL2JJ	184	VL2JF	155
VL2JL	182	VL2JF	136
VL2JM	178	VL2JG	123
VL2JC	166	VL2JN	96

VL2JM operated only twice out of the four periods whilst 2JF and 2JG missed one period.

Gradings are as follows:-

"A" DIVISION

VL2JL
VL2JJ
VL2JL
VL2JM
VL2JC

"B" DIVISION

VL2JH
VL2JE
VL2JF
VL2JG
VL2JN

VL2JF was one of the disappoints, not altogether due to Section Leader Harold Peterson VK2HP. Harold had arranged a roster of operators so that the burdens would be equally shared, but nevertheless a couple of chaps attached to the station failed to turn up when due for duty. This shows a very poor spirit and throws the work on the "Always faithful Few." Better luck next time, om.

VL2JH lost a considerable number of points through inability to sign on punctually, and had to be called up several times during different exercises. All this wastes time chaps, and brings down the average rate for each message. It is essential that the receiver be kept tuned into control at all times.

VL2JM did quite well, but has a Message Handling Procedure all of his own. Lost a few points through inability to be present at his station during a full message handling period. Dislikes the background noises at Control. Reckons that it sounds like a rats nest sometimes. Boy if you had to listen to some of the sounds that pass for an intelligible speech at times you'd realise quite a few things.

In the last issue of the magazine members were informed that the exercises would be held on Tuesday and Friday nights. Subsequent to this announcement several section leaders stated that it would be difficult for their operators to be present at night

during an exercise although they would be available during an emergency. It was decided to hold a ballot with the result that half the leaders were in favor of night operation and the other half in favor of daytime. It was then decided that Exercises would be held on Friday nights and Sunday mornings.

It is again stressed just how important it is that your station should be constantly tuned to Control. During the last round of exercises it was necessary to call VL2JH and VL2JC constantly over the air and eventually they had to be raised by landline. The same is true in a smaller degree of 2JG. You chaps should realise just how much time can be wasted when you miss your call and how dangerous this could be in an actual raid. So fellows "keep em listening."

VICTORIAN DIVISION

Those who were present at the last meeting were treated to a feast...of apples...all home grown. These apples were brought along to the meeting by 3IG who has an orchard out at Mitcham. Thanks George, we'll be very pleased to see you any time...and your apples too.

Ivor Morgan 3DH who is drawing up a scheme for an EGN put some ideas before the last meeting, inviting discussion and ideas from those present. Since the last meeting circulars have been sent out to all Hams in Victoria, asking if they would be available to operate stations. The response has been gratifying and is helping considerably in finalising any scheme put up to the authorities.

At the next meeting which will be held on Tuesday, 4th May, it is hoped that some finality will be come to in regard to the scheme. Everyone interested is advised to attend the meeting, as there will be a discussion on the matter...so come along and help.

It will be noticed in the Federal Headquarters Notes that the combined effort in regard to the P.O.W. Fund stands at £41/7/6. It seems to us that there is no reason why we should not continue to increase that amount. So if you've got a donation to send along...send it to your Divisional Treasurer.

Our Treasurer and his Good Wife are again spending a working holiday in the country. After spending 10 days or so in the northern area of Victoria, they arrived home for a week only to be sent down into Gippsland for a while...What are the mushrooms like, Elva and Jim???

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Meeting Night—First Tuesday in each month.

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VK2NG; R. SMITH, VK2AIU; R. MILLER.

The Division meets on the Third Thursday of each month at Y.M.C.A. Buildings, Pitt Street, Sydney, and an invitation is accorded to all Amateurs to be present.

HAMS !

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WESTERN AUSTRALIA:

BOX N.1002, G.P.O., PERTH.

TASMANIA:

BOX 547E, G.P.O., HOBART.